Remarks

Status of application

Claims 1, 3-24, and 26-45 were examined and stand rejected in view of prior art. The claims were previously amended to further distinguish Applicant's invention. Applicant now offers additional remarks and comments, for clarifying the claimed invention. Reexamination and reconsideration are respectfully requested.

The invention

For a summary of Applicant's invention, please refer to Applicant's Amendment filed on August 13, 2007.

Prior art rejections

Section 102 rejection: Brown et al. (US Publication 2003/0093408)

Claims 1, 3-24, and 26-45 stand rejected under 35 U.S.C. 102(e) as being anticipated by Brown et al. (US Publication 2003/0093408). The Examiner's rejection of claim 1 is representative:

> As per claim 1, Brown teaches "In a database system including a database optimizer normally used for generating an access plan for processing a given database query run against the database system, an optimizer-based method for recommending database indexes to be created for maximizing system performance, the method comprising:" (see Abstract)
>
> "capturing a workload representative of database queries employed during prior database system use;" (paragraphs 0050,0052,0054,0142, wherein a workload that includes a set of queries in a database system is stored)
>
> "monitoring the database optimizer as it prepares to optimize each of the queries, by recording all potential database physical indexes which do not currently exist in the database and for which the database optimizer searched during a preoptimization phase that occurs prior to access plan

generation;" (paragraph 0048, 0049, 0056, wherein potential recommended indexes are identified and represented visually)

"creating an initial set of virtual indexes each simulating presence of a class of potential database physical indexes that were recorded during said monitoring step," (paragraph 0046, 0075, 0076, 0077, wherein INITIATE INDEX ANALYSIS specifies a list of indexes for recommendation) "wherein each said virtual index comprises an in memory data structure corresponding to a set of potential database physical indexes;" (paragraphs 0082, 0113, 0114, 0117, 0126, 0129, 0130, 0131, wherein index recommendations are in a table that needs validation before application)

"computing cost benefits for different subsets of the set of virtual indexes by invoking the database optimizer again for purposes of providing cost estimates for the, workload for each such subset, progressively eliminating a fixed percentage of virtual indexes with the lowest expected improvement in the query's estimated cost from consideration until space that would be occupied by the virtual indexes is less than or equal to a user-specified value;" (paragraphs 0079,0126,0127,0128, wherein th~ index wizard server module calculates cost analysis of recommended indexes)

"and recommending database physical indexes to be created based on those virtual indexes that have favorable estimated cost benefits for the captured workload and have not been eliminated from consideration." (paragraph 0050, 0080, 0081, 0082, 0130,0135, wherein index recommendations are made to a user)

For the reasons stated below, Applicant's claimed invention is fundamentally different.

As previously described to the Examiner (e.g., in Applicant's first-filed Amendment), Applicant's Index Consultant invention uses an optimizer-based approach where each virtual index is used to represent a set or class of potential physical indexes. How virtual indexes are created in Applicant's system and what they look like once

created differs substantially from prior art approaches. Although Brown does teach an optimizer-based approach (and is therefore more relevant than Lenzie), Brown still shares the same deficiency that is present in other prior art systems. Prior art solutions, including Brown (and previously-cited Lenzie), do not use a "virtual index" to represent an entire class of potential physical indexes, as required by Applicant's claims. This is not merely a theoretical difference provided by Applicant's invention, but is a practical difference that has a substantial impact on system performance.

With regard to any use of virtual indexes, Brown offers little or no additional teaching beyond what the Examiner has already cited from Lenzie: both references are totally devoid of any teaching or suggestion that a virtual index be used to represent an entire class of potential physical indexes. Although Brown discusses "index groups" (e.g., Brown at paragraphs [0160-0174]), Brown's index groups bear little resemblance to the classes of potential physical indexes that are represented by virtual indexes in Applicant's system. For Brown, the index group serves as a concise representation that could map to multiple physical indexes. However, Brown's index group is not used in the same manner as Applicant's virtual index to represent classes of potential physical indexes. During optimization, Brown's system regenerates all of the physical indexes (of the index group) and treats each one as a single item. In Applicant's system, in contrast, the virtual index remains a broad specification (i.e., represents an entire class of potential physical indexes) that the optimizer uses natively (i.e., acts on it individually). Although during the optimization process a given virtual index may be altered, Applicant's optimizer always works natively with the classes of indexes (i.e., virtual indexes) -- that is, treats each virtual index (class of potential physical indexes) as if it were a single index.

Brown's system may group indexes together at one point, but during optimization his system splits out the group into individual indexes (which his optimizer must then deal with individually). Thus for instance during cost analysis, Brown's optimizer must deal with each individual index as the group has at that point already been broken up. In Applicant's system, in contrast, all of the cost analysis may be performed in virtual index form, all while the indexes are still represented as a class of indexes. This difference is set forth in particular detail in Applicant's independent claims (that were amended in

conjunction with a previously filed RCE). For example, claim 1 recites:

> **computing cost benefits** for different subsets **of the set of virtual indexes** by invoking the database optimizer again for purposes of providing cost estimates for the workload for each such subset, progressively eliminating a fixed percentage of virtual indexes with the lowest expected improvement in the query's estimated cost from consideration until space that would be occupied by the virtual indexes is less than or equal to a user-specified value;
> (Applicant's claim 1, in this is added.)

As explicitly shown in Applicant's claim language above, cost benefit analysis is performed by the optimizer against the virtual indexes, not against a multitude of individual indexes (as done in the case of Brown).

This difference has a tremendous impact on system performance. Since Brown's optimizer lacks the ability to treat Brown's index group as if it were a single native index, Brown's system is unable to approach the level of performance obtained by Applicant's system (in fact, up to one order of magnitude of performance difference, at runtime). Thus as shown, Applicant's claimed approach is not only different but provides a practical benefit that greatly enhances the performance of database systems, providing demonstrable real-world cost savings.

For the reasons stated, it is respectfully submitted that Applicant's Index Consultant invention, as set forth in the pending claims, represents a patentable advance over the art. Applicant's approach operates on a whole class of indexes (i.e., treated as a single index) during optimization, instead of the less efficient approach of the prior art of operating on a multitude of individual indexes. This approach is not taught or suggested by Brown (or other art of record). In view of the foregoing clarifying remarks (as well as previous amendments made), it is respectfully submitted that the claims are patentable under Section 102.

Any dependent claims not explicitly discussed are believed to be allowable by virtue of dependency from Applicant's independent claims, as discussed in detail above.

Conclusion

In view of the foregoing remarks and the amendment to the claims, it is believed that all claims are now in condition for allowance. Hence, it is respectfully requested that the application be passed to issue at an early date.

If for any reason the Examiner feels that a telephone conference would in any way expedite prosecution of the subject application, the Examiner is invited to telephone the undersigned at 408 884 1507.

Respectfully submitted,

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